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★TOKE P31;S05 2001-509198/56 ★JP 2001195610-A

Image processor used in medical imaging system, displays input annotation based on input positional information of annotation where it has to be added to image data

TOSHIBA KK 2000.01.12 2000JP-003595

T01 (2001.07.19) G06T 17/40, A61B 5/00, 6/00, G06T 1/00, 15/00, H04N 1/387

Novelty: The annotation position input units (2,3) input the annotation along with the positional information of the annotation where it has to be added to image data. An annotation display unit (4) displays the annotation based on the input positional information.

Use: For measurement in medical imaging system such as X-ray computer tomography device, ultrasonic imaging device, magnetic resonance imaging (MRI) device.

Advantage: Preservation of the annotation added to the voxel data set is performed easily and additional display of annotation is also performed effectively.

Description of Drawing(s): The figure shows the schematic diagram of image processor.

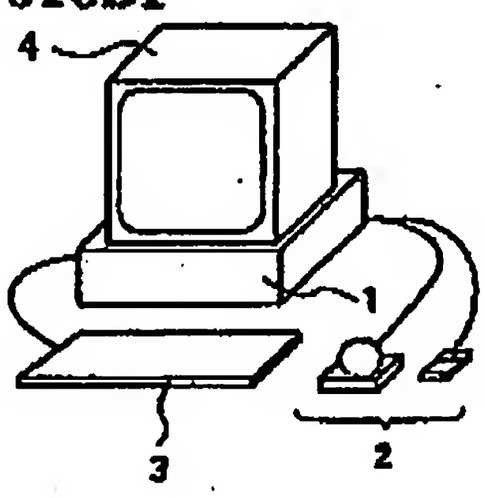
Input units 2,3

Display unit 4

(8pp Dwg.No.1/13)

N2001-378457

S05-D02A5; T01-J06A; T01-J10B1



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CLAIMS

[Claim(s)]

[Claim 1] An image processing system characterized by having an annotation location input means to associate and add positional information of said annotation to said three-dimension image data in an image processing system which can add and display an annotation on three-dimension image data, and an annotation display means which displays this annotation based on positional information of said annotation.

[Claim 2] Said annotation location input means is an image processing system according to claim 1 characterized by adding by associating positional information of said annotation to one [at least] image data among a plane cut image or a MPR image.

[Claim 3] Said annotation location input means is an image processing system given in either of claims 1 or 2 characterized by adding positional information of said annotation to image data of a plane cut image of two or more sheets, or a MPR image.

[Claim 4] Said annotation display means is the image processing system of any one publication in claims 1-3 characterized by displaying said annotation based on positional information associated to one [at least] image data among a plane cut image or a MPR image.

[Claim 5] Said annotation display means is the image processing system of any one publication in claims 1-4 characterized by adding positional information of said annotation to image data of a plane cut image of two or more sheets, or a MPR image.

[Claim 6] Said annotation display means is the image processing system of any one publication in claims 1-5 characterized by having an annotation display-control means which carries out a display / non-display control of said annotation according to physical relationship of a cutting plane displayed at least in one side among a plane cut image or a MPR image, and positional information of the thickness direction where said annotation was added.

[Claim 7] Said annotation display-control means is the image processing system according to claim 6 characterized by equipping arbitration with a selectable display selection means for a display / un-displaying for said each annotation of every.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the image processing system which performs an image processing for the purpose of diagnostic imaging or measurement in a medical image system etc.
[0002]
[Description of the Prior Art] In the X-ray CT which is medical image diagnostic equipment, MRI, an ultrasonic diagnostic imaging equipment, etc., voxel data (Voxel Data) which is referred to at drawing 9 based on collected measurement data is created. After creating this voxel data, the operator is creating images, such as volume rendering (Volume Rendering) and MPR (Multi-Planar Reconstruction), for the purpose.
[0003] Furthermore, an operator adds an annotation (Anotation) on the image created for the purposes, such as an operation plan and informed consent (InformedConcent). The annotation pointed out here is defined as follows and let it be the graphic form and text which are added to the area of interest on an image etc. for the explanation to a third person, or a comment. One example of this annotation is shown in drawing 10 .
[0004] In medical image diagnostic equipment etc., the needs of the three-dimension diagnostic imaging accompanying improvement in the speed of the scan speed for data collection or development of three-dimension scan technology are increasing. Furthermore, creation of an interactive (Interactive) image is demanded with an operation plan or generalization of informed consent. The advance of the computer technology in recent years makes it possible to provide a high speed with an image. Thus, the image which is generally created as a three-dimension image among the images offered, and is used is explained.
[0005] (1) Rendering image drawing 11 is the mimetic diagram of volume rendering processing to the voxel data set 17. Drawing 11 is [as opposed to / especially / plane of projection 18] the mimetic diagram of parallel projection with all perpendicular projection light 22. Volume rendering processing outputs the integral value of the voxel value on projection light 22, and an accumulation value with weight to the image pixel on plane of projection 18.
[0006] A rendering image points out the two-dimensional image generated on plane of projection 18 at this time. Plane of projection 18 and projection light 22 can be set up with an easy equation, if the xyz coordinate in drawing is used. Moreover, an operator can set up in the direction (the direction of the projection light 22 in drawing) which means the voxel data set 17, or can set up freely the parameter used in the case of creation of an image.
[0007] (2) MPR image drawing 12 (A) is the mimetic diagram of the MPR processing which generates the MPR image 23 shown in drawing 12 (B) from a voxel data set. An operator sets up the cutting plane 19 of the arbitration which cuts the voxel data set 17. At this time, a cutting plane 19 stores in the image pixel on a cutting plane 19 the value of the voxel which crosses the voxel data set 17. If it puts in another way, it will be the two-dimensional image generated by the image pixel on a cutting plane 19 in the MPR image 23. Interpolation processing of the voxel data may be suitably carried out in the case of storing of data. A mathematical expression and setup of a cutting plane can be easily performed using a rectangular coordinate system.
[0008] (3) Plane cut image drawing 13 (A) is the mimetic diagram of the plane cut (Plane Cut) processing which generates the plane cut image 20 (it is hereafter described as PC image.) from the voxel data set 17. Moreover, drawing 13 (B) is the mimetic diagram of the PC image 20 generated by plane cut processing of drawing 13 (A). Although plane cut processing is similar with MPR processing in that the voxel data set 17 is cut by the cutting plane 19 which an operator sets up, it is the image with which the PC image 20 projected the crossover field (continuous tone portion of drawing 13 (A)) of a cutting plane 19 and the voxel data set 17 on plane of projection 18 to a MPR image being an image generated on a cutting plane 19. [0009] Although ray tracing is performed in the direction which goes to plane of projection from a view 23 in case the PC image 20 is furthermore generated, the voxel which exists between a view 23 and a cutting plane 19 among the voxel on light at this time is disregarded. Moreover, it sees from a view 23 and the voxel data set 17 of a far side is also disregarded from a cutting plane 19. That is, only the voxel on a cutting plane 19 is projected on plane of projection 18. (However, in digital processing, interpolation processing is performed using the about 19-cutting plane voxel, and a projection value is determined.) If it puts in another way, after removing all the voxel between a view 23 and a cutting plane 19, in the PC image 20, it will be the image which projected the surface (crossover field with a cutting plane) of the voxel data set 17 on plane of projection 18. Moreover, as shown in drawing 13 (B), usually the rendering image 21 is generated by fields other than PC image.
[0010] Moreover, the PC image 20 does not necessarily need to be only one image, and two or more PC images 20 may be generated on one plane of projection. In that case, what is necessary is just to repeat the computation explained above to each cutting plane 19, although it is necessary to carry out the multi-statement of the cutting plane 19.
[0011]
[Problem(s) to be Solved by the Invention] However, the annotation was conventionally added to the image

beforehand created from voxel data to addition. In the way of adding an annotation to the rendering image created from such voxel data, or a MPR image, interactive creation of an image and addition of an annotation, and a display cannot be performed.
[0012] moreover, three-dimension **** -- a two-dimensional image -- differing -- "-- ** -- since the treatment of" information is needed, even if it adds the annotation to voxel data simply, it becomes only the fixed display and the display of the effective annotation according to the depth cannot be performed.
[0013] This invention adds the annotation to voxel data beforehand, and in case it creates the image for which an operator asks, it is to offer the image processing system which displays an annotation interactively and effectively.
[0014]
[Means for Solving the Problem] Let it be a solution means to have an annotation location input means to associate and add positional information of said annotation to said three-dimension image data, and an annotation display means which displays this annotation based on positional information of said annotation with an image processing system by which it is characterized in an image processing system which can add and display an annotation on three-dimension image data in this invention according to claim 1 in order to solve the above technical problems.
[0015] Moreover, in this invention according to claim 2, said annotation location input means makes it a solution means to add by associating positional information of said annotation to one [at least] image data among a plane cut image or a MPR image with an image processing system according to claim 1 by which it is characterized.
[0016] Moreover, in this invention according to claim 3, said annotation location input means makes it a solution means to add positional information of said annotation to image data of a plane cut image of two or more sheets, or a MPR image with an image processing system of a publication at either of claims 1 or 2 by which it is characterized.
[0017] Moreover, in this invention according to claim 4, said annotation display means makes it a solution means to display said annotation based on positional information associated to one [at least] image data among a plane cut image or a MPR image with an image processing system of any one publication in claims 1-3 by which it is characterized.
[0018] Moreover, in this invention according to claim 5, said annotation display means makes it a solution means to add positional information of said annotation to image data of a plane cut image of two or more sheets, or a MPR image with an image processing system of any one publication in claims 1-4 by which it is characterized.
[0019] In this invention according to claim 6 moreover, said annotation display means An annotation display-control means which carries out a display / non-display control of said annotation according to physical relationship of a cutting plane displayed at least in one side among a plane cut image or a MPR image, and positional information of the thickness direction where said annotation was added Let it be a solution means to have with an image processing system of any one publication in claims 1-5 by which it is characterized.
[0020] Moreover, in this invention according to claim 7, said annotation display-control means makes it a solution means to equip arbitration with a selectable display selection means for a display / un-displaying for said each annotation of every with an image processing system according to claim 6 by which it was characterized.
[0021]
[Embodiment of the Invention] The input method of an annotation using the image processing system by the gestalt of operation of this invention is explained. The gestalt of this operation explains how to input an annotation using 3 of a rendering image, PC image, and a MPR image images.
[0022] Drawing 1 shows the outline for explaining the configuration of the image processing system by the gestalt of operation of this invention.
[0023] First, it consists of a pointing device 2 which consists of a mouse or a trackball used in order to set up the arithmetic unit 1 for performing predetermined data processing, and actuation of an actuation screen and the location of a cutting plane, a keyboard 3 used for actuation of an image processing system or a text entry of data, and an image display device 4 which consist of bases.
[0024] Moreover, drawing 2 is an example for explaining the configuration of a display of the display screen of the image processing system by this invention. the screen which displays the rendering image and plane cut image which are shown as the actuation screen which a division indication of the screen display of an image display device 4 is given from the three contents of a display, and is shown as Screen A in drawing 2 , and Screen B in drawing 2 , and the screen which displays the MPR image shown in Screen C in drawing 2 -- since -- it is constituted.
[0025] Among these, the optional feature of the voxel data set which is not illustrated, the input function of many parameters, such as a view location required in order to create a rendering image, and transparency, the setting up function of the cutting plane for creating a MPR image and PC image, etc. are displayed on Screen A displayed as an actuation screen as a user interface. Moreover, the aforementioned pointing device 2 is used for the alter operation to this actuation screen. Below, order is explained for the alter operation to this actuation screen later on for every phase of steps 1-7.
[0026] [Step 1] An operator first chooses the voxel data set which operates and asks for a pointing device 2 or a keyboard 3 according to the actuation screen displayed on Screen A.
[0027] [Step 2] An operator creates the rendering image 5 from the selected voxel data set. The purpose is for grasping the overview of an inspection object domain from the rendering image 5, and recognizing the physical relationship of an area of interest and an overview. The created rendering image 5 is displayed on Screen B of drawing 2 . In addition, if, as for creation of the rendering image 5, an operator can grasp the relation between an area of interest and the whole inspection zone only by PC image, this rendering image 5 does not necessarily need creation and to be displayed, but omitting to arbitration is also possible.
[0028] [Step 3] As shown in Screen B of drawing 3 , the PC image 6 is created and displayed on the rendering image 5

created at step 2. Moreover, an operator enables it to observe an area of interest by adjusting the view location of the rendering image 5, and the location of a cutting plane from the direction for which it asks. The created PC image 6 is displayed in piles on the rendering image 5 created at step 2.

[0029] [Step 4] A setup of the cutting plane for creating the PC image 6 at step 3 creates automatically the MPR image 7 using the cutting plane by the computer. The created MPR image is displayed on Screen C, as shown in drawing 3.

[0030] [Step 5] Next, an operator inputs an annotation on Screen C of drawing 3. Screen C shown in drawing 4 is one of them. An annotation 8 is ****(ed) by a graphic form and the text. In the actuation screen shown on Screen A of drawing 2, the user interface for graphic form edit or text editing possesses. These edits are performed by operating the pointing device 2 and keyboard 3 of drawing 1.

[0031] [Step 6] The location displayed on the annotation 8 edited into the degree is registered. An operator operates a pointing device 2 and registers the location of an annotation 8. If one on the MPR image 7 is specified by the place marker 9 as shown in drawing 5, the location of the point will be registered as a location of an annotation 8. The location of the point can be easily expressed, if the rectangular coordinate system set as the voxel data set is used. Since the registration location of an annotation 8 is a point which exists on a cutting plane, if the cutting plane is expressed with the rectangular coordinate system, the position coordinate of a registering point can be searched for easily. In addition, in the example of drawing 4, the graphic form and the text are treated as one annotation 8.

[0032] [Step 7] If edit and registration of one annotation 8 are completed, a repeat and a required number of annotations 8 will be registered for from step 3 to the step 6.

[0033] As mentioned above, from step 1 to the step 7 is the method of registering an annotation 8 to a voxel data set. Although edit and registration of an annotation 8 were performed on the MPR image 7 by the method of the above-mentioned explanation, it is also possible to perform edit and registration of an annotation 8 on the PC image 7, as shown in drawing 6. Even in this case, since the registration location of an annotation 8 is a point which exists on a cutting plane, if the cutting plane is expressed with the rectangular coordinate system, the position coordinate of a registering point can be searched for easily.

[0034] Next, how to display the registered annotation is explained.

[0035] [Step 1] First, an operator does alter operation of a pointing device 2 or the keyboard 3 according to the actuation screen displayed on Screen A, and chooses a desired voxel data set.

[0036] A [step 2] operator creates the rendering image 5 from the selected voxel data set. The created rendering image 5 is the same as that of the example shown in Screen B of drawing 2. However, the rendering image 5 created at this time hopes that it is not necessarily the same as that of the rendering image 5 created on the occasion of the input of an annotation 8.

[0037] [Step 3] operator sets up the cutting plane for creating the PC image 6 on the rendering image 5 created at step 2. The PC image 6 generated at this time is the same as that of the example of drawing 3. However, the PC image 6 created at this time hopes that it is not necessarily the same as that of the PC image 6 created on the occasion of the input of an annotation 8. Moreover, besides the PC image 6, the MPR image 7 using the same cutting plane may be generated automatically and displayed.

[0038] [Step 4] arithmetic unit 1 judges whether the registration location of the annotation 8 registered on the cutting plane exists. When a registration location exists, as shown in drawing 7, it displays in piles on the PC image 6 or the MPR image 7. The display information which may be the fixed display information and can carry out a reorganization collection by the PC image 6 or the MPR image 7 is also available for the displayed annotation 8. Moreover, an operator is able to set up a display / un-displaying using a pointing device 2. [of an annotation 8]

[0039] [Step 5] operator's resetting of a cutting plane eliminates the annotation 8 of the registration location which stopped existing on a cutting plane from on a screen. And the annotation 8 of the registration location which exists on a new cutting plane is displayed.

[0040] By a series of actuation of step 1 to the above step 5, whenever an operator changes a setup of a cutting plane, he can display the annotation 8 registered beforehand on the PC image 6 or the MPR image 7.

[0041] Next, the judgment method of whether the registration location of an annotation 8 exists on a cutting plane is explained using drawing 8.

[0042] The registration location 10 of a cutting plane 12 and an annotation 8 is expressed by the rectangular coordinate system (x y, z) fixed to the voxel data set 11 as above-mentioned. Especially the cutting plane 12 can be expressed by the following (1) formula.

[0043]

The formula expressing a cutting plane: $a*x+b*y+c*z=d$ -- (1)

However, (a, b, c) are taken as the unit normal vector of a cutting plane.

[0044] here -- an annotation -- eight -- registration -- a location -- ten -- (-- xp -- yp -- zp --) -- ** -- carrying out -- if -- registration -- a location -- ten -- a cutting plane -- 12 -- distance -- as follows -- asking -- having -- a point (Xp, Yp, Zp) -- a passage -- a cutting plane -- 12 -- being perpendicular -- a straight line -- (-- two --) -- a formula -- giving -- having .

[0045]

$(x\ y, z) = (Xp, Yp, Zp) + t^* (a, b, c)$ -- (2)

If the solution T of the simultaneous equations which consist of an equation (1) and an equation (2) is calculated, the registration location 10 of an annotation 8 and the distance L of a cutting plane 12 will be given by the following (3) formulas.

[0046] L=abs (T) -- (3)

However, abs ( ) is taken as the function which gives an absolute value.

[0047] The above-mentioned judgment is performed by comparing this distance L with the threshold H beforehand set as the system. That is, if it becomes L<=H, the registration location 10 exists on a cutting plane 12.
[0048] If it becomes L>H, the registration location 10 does not exist on a cutting plane 12.
[0049] The range which displays an annotation 8 can be adjusted by adjusting this threshold H.
[0050] In addition, as for a three-dimension image, it is common to express the location of the voxel by the rectangular coordinate system. In addition, although a spherical coordinate system may be used instead of a rectangular coordinate system, the gestalt of operation of this invention explains using a rectangular coordinate system. However, in operation of this invention, it is not limited to a rectangular coordinate system.
[0051] Moreover, the gestalt of the operation explained above was indicated in order to make an understanding of this invention easy, and it was not indicated in order to limit this invention. Therefore, each element indicated by the gestalt of the above-mentioned operation is the meaning also containing all the design changes belonging to the technical range of this invention, or equal objects.
[0052]
[Effect of the Invention] According to the image processing system of this invention, conservation management of the annotation added to the voxel data set can be carried out simple, and in case it is the display of an image, the annotation can be effectively indicated by addition.

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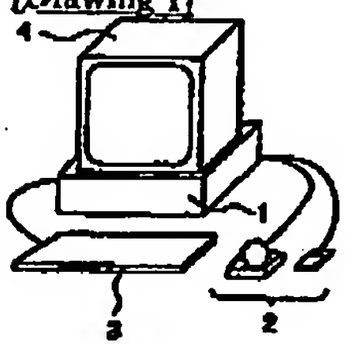
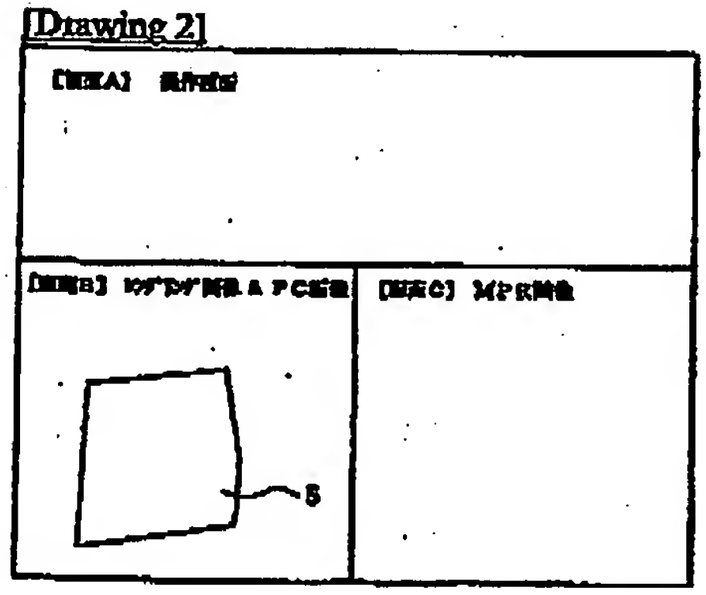
DRAWINGS

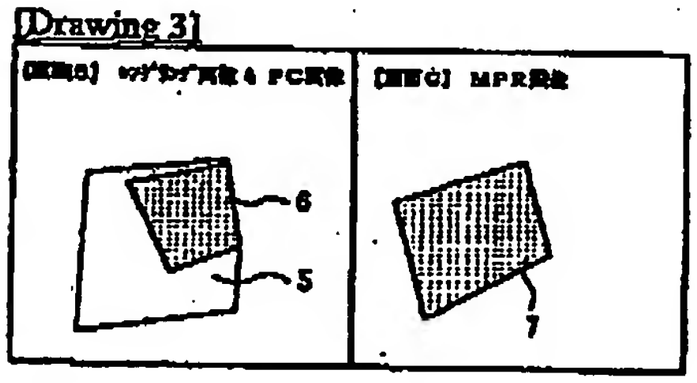
[Drawing 1]



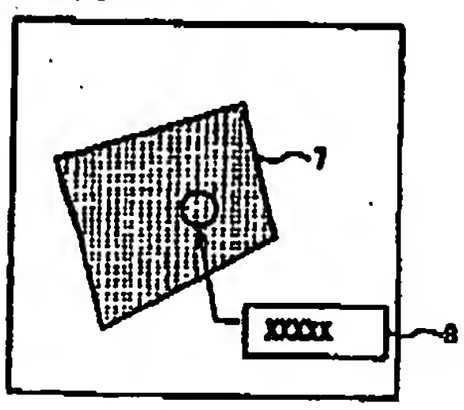
[Drawing 2]



[Drawing 3]

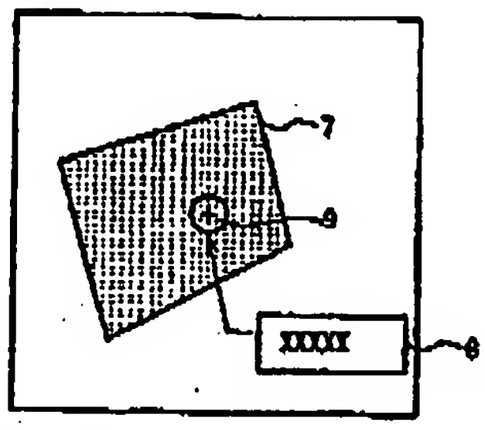


[Drawing 4]



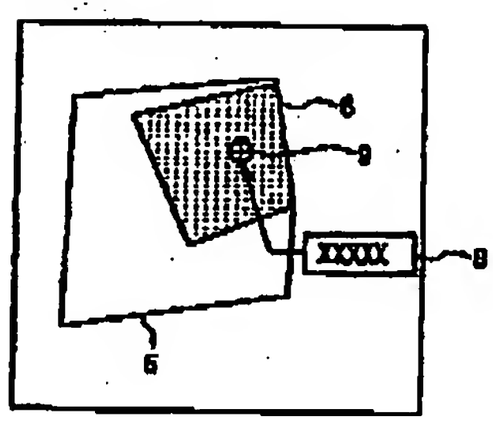
[Drawing 5]

[図面c]

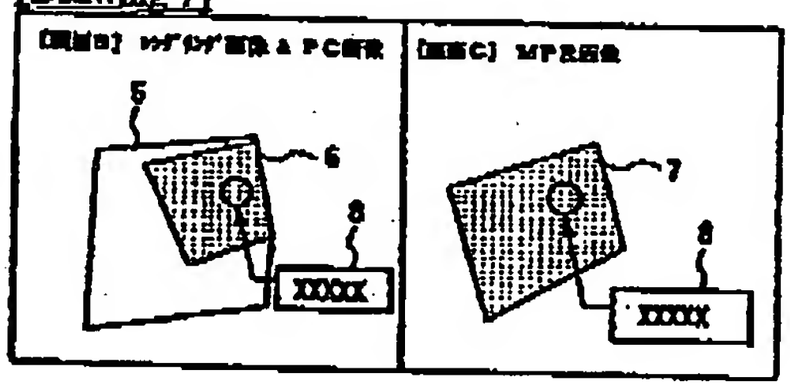


[Drawing 6]

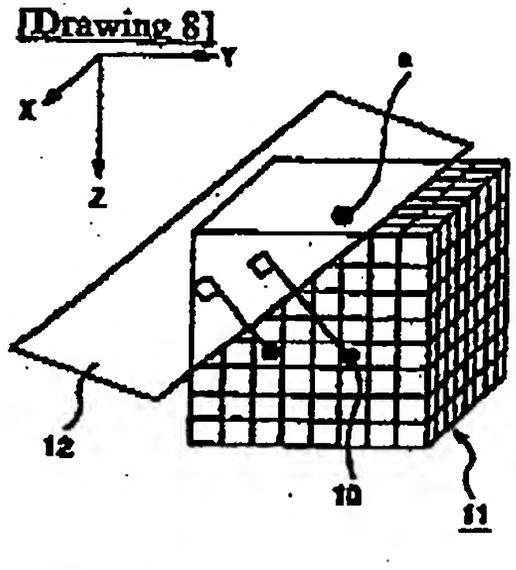
[図面a]



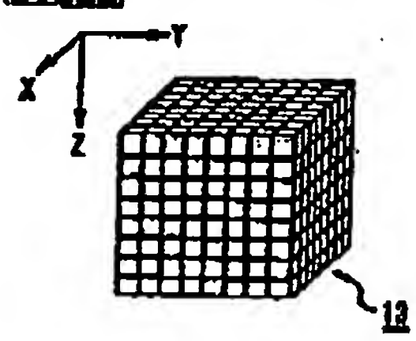
[Drawing 7]



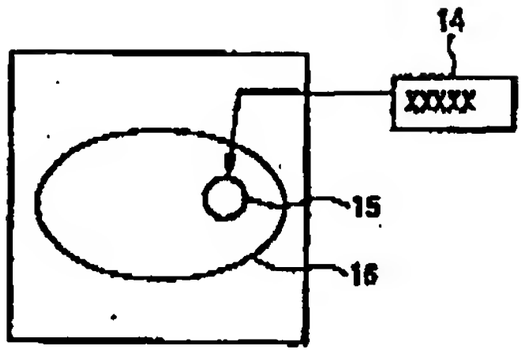
[Drawing 8]



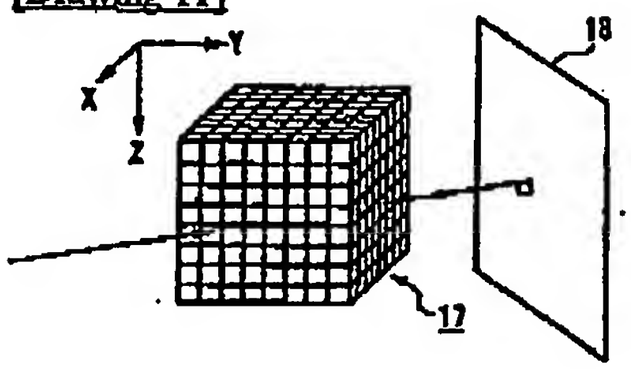
[Drawing 9]



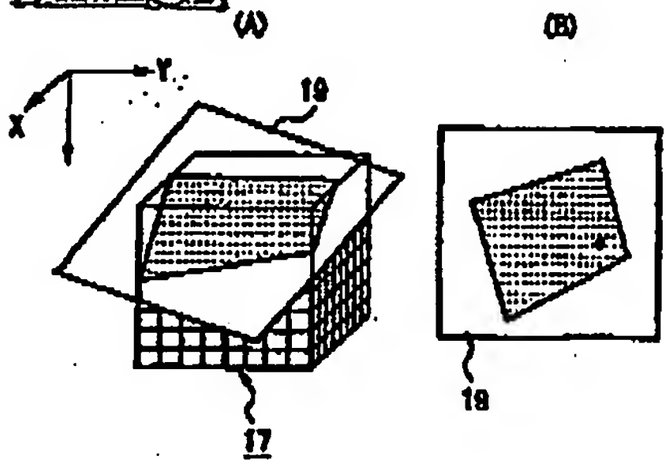
[Drawing 10]



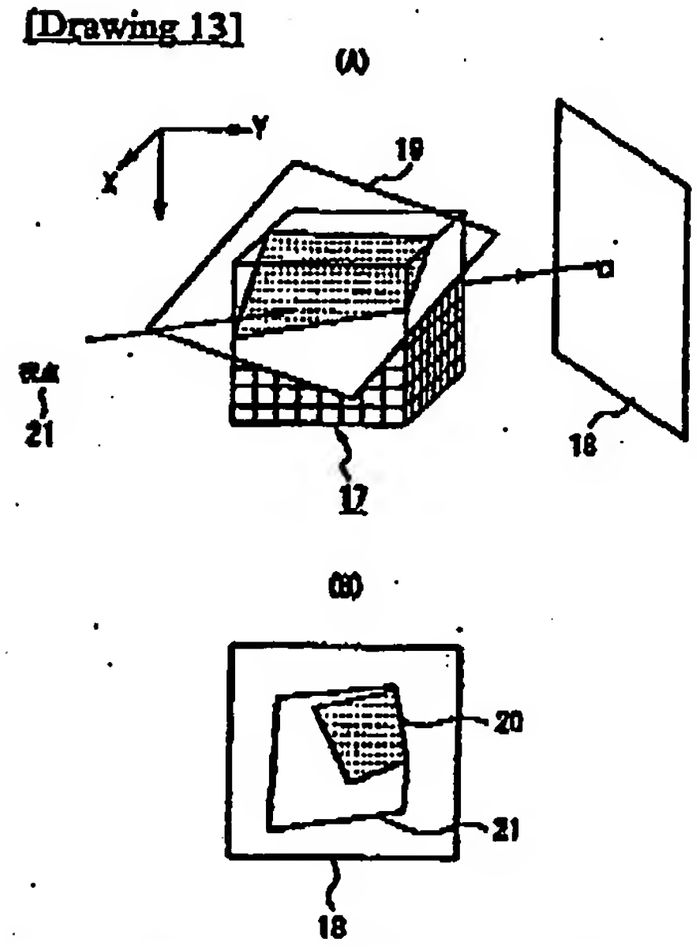
[Drawing 11]



[Drawing 12]



[Drawing 13]



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